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Motivated Rejection of Science

Stephan Lewandowsky^{1,2,3} and Klaus Oberauer⁴

Abstract

Some scientifically well-established results—such as the fact that emission of greenhouse gases produces global warming—are rejected by sizable proportions of the population in the United States and other countries. Rejection of scientific findings is mostly driven by motivated cognition: People tend to reject findings that threaten their core beliefs or worldview. At present, rejection of scientific findings by the U.S. public is more prevalent on the political right than the left. Yet the cognitive mechanisms driving rejection of science, such as the superficial processing of evidence toward the desired interpretation, are found regardless of political orientation. General education and scientific literacy do not mitigate rejection of science but, rather, increase the polarization of opinions along partisan lines. In contrast, specific knowledge about the mechanisms

underlying a scientific result—such as human-made climate change—can increase the acceptance of that result.

Keywords

rejection of science, cognition about science, science communication, science and the public

Vaccinations cause autism, climate change is a hoax, tobacco is good for you, AIDS is an invention of the U.S. government, and now even the Earth is flat again ([Strauss, 2016](#)).

Many scientific propositions that have been accepted as facts by the relevant expert communities are subject to public dispute and, sometimes, outright rejection. When sizable segments of the population reject findings from medical research, adverse consequences to public health are never far behind, as in the case of anti-vaccination movements ([Gangarosa et al., 1998](#); A. [Smith, Yarwood, & Salisbury, 2007](#)). When science denial becomes official government policy, the death toll can run into the hundreds of thousands, as in the case of South Africa's refusal to provide antiretroviral treatments for AIDS under President Thabo Mbeki ([Chigwedere, Seage, Gruskin, Lee, & Essex, 2008](#)).

In some instances, scientific findings are rejected simply because the public is misinformed about an issue. A famous recent case involves the nonexistent but widely publicized link between the measles, mumps, and rubella (MMR) vaccine and autism. At one point, belief in its existence even affected medical professionals in the United Kingdom ([Petrovic, Roberts, & Ramsay, 2001](#)). The spread of this mistaken belief was aided by inappropriate and unbalanced media reporting ([Speers & Lewis, 2004](#)), which

medical journals arguably failed to counteract ([Hilton, Hunt, Langan, Hamilton, & Petticrew, 2009](#)).

Misinformation is often difficult to rebut ([Lewandowsky, Ecker, Seifert, Schwarz, & Cook, 2012](#)), and in the case of the MMR vaccine, it took considerable effort and expenditure for vaccination rates to increase again (A. [Smith et al., 2007](#)). In many other situations, scientific findings are rejected not only because the public is misinformed about an issue but because the science is in conflict with people's worldviews, or political or religious opinions. In those cases, science is rejected on the basis of motivated identity-protective cognition that cannot be understood without consideration of the broader societal and political context. From here on, we are exclusively concerned with the U.S. context. Public opinions and the political context in other countries may be substantially different and may lead to different conclusions.

When scientists discover a planet in our Milky Way that is made entirely of diamonds ([Bailes et al., 2011](#); Galloway, 2011), public fascination and admiration are virtually assured. When the same scientific method yields discoveries that are closer to home but touch on people's lifestyle or worldviews, or impinge on corporate interests, the response can be anything but favorable. For example, many people resist medical research with behavioral or regulatory implications—such as research on the adverse health effects of tobacco or alcohol.

One striking aspect of the public's views of science is that general level of education, scientific knowledge, and science literacy are only modestly predictive of the public's general attitudes toward and trust in science (e.g., [Allum, Sturgis, Tabourazi, & Brunton-Smith, 2008](#)). Moreover, when it comes to specific scientific issues—especially those that

are politically contested—even those modest associations tend to disappear and are replaced by polarization along political lines (e.g., [Kahan et al., 2012](#)). There has been a decades-long, gradual erosion of trust in the scientific community among conservatives—but not liberals—since the mid-1970s ([Gauchat, 2012](#)). Whereas conservatives and liberals did not differ in their trust in science at the beginning of the 1970s, by 2010 the polarization had become quite striking, with liberals retaining trust in the scientific community and conservatives having reduced theirs.

This erosion of trust has coincided with the emergence of multiple scientific findings that challenge core conservative views, such as belief in the importance and beneficence of unregulated free markets. Nowhere is this more apparent than with climate science. The overwhelming scientific consensus that greenhouse gas emissions from human economic activity are warming the planet (e.g., [Cook et al., 2013](#)) is endorsed by the majority of liberals and Democrats but rejected by the majority of Republicans and conservatives (e.g., [Hamilton, 2011](#); [Hamilton, Hartter, Lemcke-Stampone, Moore, & Safford, 2015](#)).

Perhaps unexpectedly, this polarization along political lines increases with self-reported knowledge of the issue ([Hamilton, 2011](#)), scientific literacy and numeracy ([Kahan et al., 2012](#)), and education ([Hamilton, Hartter, Lemcke-Stampone, et al., 2015](#)). That is, greater education or knowledge is associated with increased acceptance of climate science among liberals but—ironically—with decreased acceptance among conservatives.

The polarization along partisan lines is not limited to climate science. For example, [Hamilton, Hartter, and Saito \(2015\)](#) showed that trust in scientists regarding vaccinations was also greater among Democrats than Republicans, and this polarization again increased with increasing education. The conservative-liberal split is particularly

amplified in attitudes toward vaccinations against sexually transmitted diseases such as the human-papillomavirus (HPV), which is responsible for cervical cancer ([Kahan, Braman, Cohen, Gastil, & Slovic, 2010](#)). The skepticism about vaccinations likely arises from conservatives' fears of government intrusion into parenting.

In summary, the rejection of specific scientific evidence across a range of issues, as well as generalized distrust in science, appears to be concentrated primarily among the political right. It does not follow, however, that there are any fundamental differences in the cognition between people of differing political attitudes and values. Quite to the contrary, the cognitive shortcuts that drive the rejection of scientific evidence appear to be politically symmetrical.

The Cognition Underlying the Rejection of Science

What do cows drink? If you were tempted to respond “milk,” then this would reflect a cognitive shortcut—a so-called heuristic—that responds to the question merely on the basis of association rather than deep reflection. Similar heuristics that affect the processing of scientific information are readily triggered in the laboratory. When participants are presented with synthetic data that are amenable to a quick—but inaccurate—interpretation, and a complex—but accurate—understanding, the quick heuristic-based interpretation is triggered whenever it is worldview congruent. The more complex and accurate reading of the data is backgrounded when it challenges participants' worldviews. [Figure 1](#) shows synthetic data used as stimuli in an experiment by [Kahan, Peters, Dawson, and Slovic \(2013\)](#). The top two tables in the figure show hypothetical results from a study involving a fictitious new skin cream, with the outcome columns (“rash got better” vs. “rash got worse”) reversed between them.

[TS: Please insert Figure 1 about here.]

Fig. 1.

Synthetic data used as stimuli in an experiment by [Kahan, Peters, Dawson, and Slovic \(2013\)](#). See text for details.

At first glance, the left-hand column in each of the two tables in panel (a) may provide all the evidence needed to determine the efficacy of the skin cream, as there are more users than non-users whose symptom improved (table on the left) or got worse (table on the right). However, this heuristic interpretation is incorrect because it fails to consider the base rates—namely, that there are nearly three times as many users than non-users. A more complete examination of the pattern would therefore yield the opposite understanding, because the proportion of non-users who improved (left) or got worse (right) far exceeded the proportion of users who experienced the same outcome.

The interpretation of these data was wholly determined by participants' numeracy: Those with greater numeric ability detected the complex pattern, whereas those with lesser ability reported the opposing conclusion based on the simpler heuristic interpretation. The moment the same data were couched in terms of gun control, with crime either increasing or decreasing (see the bottom two tables in [Fig. 1](#)) as a function of the number of cities that did or did not ban carrying concealed handguns (rows), the role of numeracy was overpowered by participants' worldview. Liberals overwhelmingly arrived at the correct interpretation when the data showed crime to decrease as a result of gun control, whereas they failed to recognize the complete pattern, and settled for the simplistic heuristic interpretation, when the data showed crime to increase. The reverse pattern was observed for conservatives. The groups did not differ appreciably in the overall extent of their

reliance on the heuristic, suggesting that the same cognitive processes were engaged to protect participants' worldviews whenever they were challenged by one or the other outcome.

In addition to triggering simplifying heuristics, motivated cognition may also express itself as biased risk assessment. For example, when participants are asked to express their views on nanotechnology, an issue about which few people are well informed, liberals and conservatives do not differ in their risk assessment. However, when information about both the risks and the benefits of the technology is provided, the two groups become highly polarized, with liberals focusing on the risks and conservatives focusing on the benefits ([Kahan, Braman, Slovic, Gastil, & Cohen, 2009](#)). That is, each group foregrounds that aspect of the information that is consonant with their worldview:

Liberals focus on environmental and health risks, and conservatives focus on the benefits of economic development. Similar arguments about differential risk perception have been advanced about climate denial (e.g., [McCright & Dunlap, 2011](#)).

A final element of motivated cognition that suffuses the rejection of science is conspiracist thinking. When people are motivated to reject an overwhelming scientific consensus, one way in which they may explain this consensus is via the ideation of a conspiracy among researchers ([Diethelm & McKee, 2009](#); [McKee & Diethelm, 2010](#)). Accordingly, around 20% of U.S. residents have been found to endorse the idea that climate change “is a hoax perpetrated by corrupt scientists who wish to spend more taxpayer money on climate research” ([Lewandowsky, Gignac, & Oberauer, 2013](#)), and when asked to indicate their affective responses to climate change (by asking respondents to provide the “first word, thought, image, or phrase that comes to mind when thinking

about global warming”), the public’s most common response has been found to be conspiratorial in nature, for example by responding with “hoax” (N. [Smith & Leiserowitz, 2012](#)). In a blind test, discourse on climate-change-contrarian blogs was found to be suffused with conspiracist attributes ([Lewandowsky et al., 2015](#)). Conspiracist ideation is also known to be involved in the rejection of many other well-established scientific propositions, such as the link between the HIV virus and AIDS ([Kalichman, 2009](#)) and denial of the benefits of vaccinations ([Briones, Nan, Madden, & Waks, 2012](#)). The prevalence of conspiracist ideation has not been firmly linked to one or the other side of the political spectrum. On the contrary, a recent study suggested that the endorsement of conspiracy theories is associated with political extremism irrespective of its polarity ([van Prooijen, Krouwel, & Pollet, 2015](#)).

In summary, the basic cognitive processes implicated in the rejection of science—namely, cognitive shortcuts, differential risk perception, and conspiracist cognition—appear to be universal and engaged on both sides of the political aisle. At first glance, this conclusion may appear at odds with the earlier discussion that identified distrust of scientists and the rejection of evidence as being primarily concentrated among the political right. One possible explanation for the asymmetry observed “in the wild” invokes the current historical and political context, in which publicly contested scientific findings primarily happen to challenge the worldviews of conservatives rather than liberals. On this account, the laboratory results would lead us to expect that the reverse pattern could be observed if science were to yield evidence contrary to a liberal worldview. We would also expect there to be no polarization along partisan lines for scientific findings that do not challenge anyone’s worldview—and this is exactly what

[Kahan \(2015\)](#) reported for risk attitudes toward a number of issues, among them artificial food coloring and sweeteners, cell phone radiation, genetically modified food, and exposure to high-voltage power lines.

An alternative explanation recognizes that trust in scientists is lower among conservatives than among liberals even for issues on which conservatives might agree with the prevailing scientific opinion—for example, on the safety of nuclear power or genetically modified organisms ([Hamilton, 2015](#)). On this account, the observed political asymmetry of the rejection of science reflects a deeper and more pervasive distrust of science by conservatives rather than historical coincidence. We suggest that those two competing explanations cannot be fully differentiated on the basis of the existing evidence.

Rational Denial

No discussion of the rejection of science can be complete without recognizing the role of institutionally organized denial ([Brulle, 2013](#); [Dunlap & Jacques, 2013](#); [McCright & Dunlap, 2003](#); [Proctor, 2011](#)). In scientific research on topics from tobacco or leaded gasoline to climate change or alcohol, the fingerprint of corporate interference is readily detectable. Recent research has confirmed the effectiveness of such organized denial—for example, by showing that people’s attitudes toward climate science can be compromised by misleading information ([McCright, Charters, Dentzman, & Dietz, 2016](#); [Ranney & Clark, 2016](#)). Organized denial of science is therefore best considered an entirely rational operation that has clear political and economic goals. Seen in this light, the tobacco industry’s conspiracist labeling of medical research as a “cartel” that “manufactures alleged evidence” ([Abt, 1983](#), p. 127), or U.S. Senator Inhofe’s reference

to climate change as a “hoax” ([Inhofe, 2012](#)), are rational and effective ([McCright et al., 2016](#); [Ranney & Clark, 2016](#)) tools in a political arsenal.

Similarly, [Cook and Lewandowsky \(2016\)](#) have shown within a Bayesian framework that the rejection of evidence can be modeled by a rational belief-updating system under some circumstances. Cook and Lewandowsky showed that participants who strongly supported free-market economics lowered their acceptance of human-caused global warming in response to information about the scientific consensus. This “backfire” effect could be modeled within a rational framework because people adjusted their trust in climate scientists downward, thereby not only avoiding an adjustment of their belief in the science but also safe-guarding their endorsement of free-market economics.

Thus, although the rejection of scientific evidence can have notable adverse consequences for society, it does not follow that the people who reject science do so in an irrational manner. Denying the health effects of tobacco may kill people, but it rationally maximizes the profits of the tobacco industry. The recruitment of conspiracist ideation in support of this goal is therefore a politically rational move.

Communicating Contested Science

Although the rejection of science may be driven by a common set of cognitive processes, it is clear that political, ideological, and economic factors are paramount. The communication of contested science is therefore inextricably caught up in political battles, and at least in the case of climate change, it is unlikely that communication alone can achieve a reduction in polarization. People’s opinions are partly shaped by the elite cues provided by political leaders ([Brulle, Carmichael, & Jenkins, 2012](#)), and without a

significant change in those cues, scientific communication efforts face considerable challenges.

Nonetheless, recent research on climate communication has identified several techniques that can assist in communicating contested scientific findings . For example, a mere change in wording—from “tax” to “offset”—increased Republicans’ willingness to pay for carbon-producing activities ([Hardisty, Johnson, & Weber, 2010](#)). Informing people about the pervasive scientific consensus on climate change has also repeatedly been shown to increase acceptance of science across the political spectrum ([Cook & Lewandowsky, 2016](#); [Lewandowsky, Gignac, & Vaughan, 2013](#); [van der Linden, Leiserowitz, Feinberg, & Maibach, 2015](#)). One occasional exception involves Americans who are strong adherents of free-market economics ([Cook & Lewandowsky, 2016](#)). Other research has identified the use of narratives—that is, personal anecdotes or “storytelling”—as a powerful means to communicate science (e.g., [Dahlstrom, 2014](#)). In politicized environments, communication can be informed by research on source credibility to maximize the likelihood that information will be accepted by the audience ([Lupia, 2013](#)).

Finally, even though general education and science literacy are not associated with acceptance of climate science ([Kahan et al., 2012](#)), recent evidence suggests that providing a brief mechanistic explanation of the basic greenhouse effect can reliably and lastingly enhance acceptance across the political spectrum ([Ranney & Clark, 2016](#)).

Current Directions

We have not touched on the role of personal characteristics other than people’s worldview. A recent body of work has identified several individual-difference variables,

such as belief in the paranormal ([Lobato, Mendoza, Sims, & Chin, 2014](#)), that may be associated with attitudes toward science. We expect further research along those lines. Relatively little is known about the “microcognition” involved in the rejection of science. The work of [Ranney and Clark \(2016\)](#) and [Kahan et al. \(2013\)](#) presents promising pointers in that direction, as does the research on conspiracist thinking, but we do not yet have access to a comprehensive body of knowledge about how people actually think when confronted with scientific evidence or facts.

Recommended Reading

Cook, J., & Lewandowsky, S. (2012). *The debunking handbook*. Retrieved from <http://sks.to/debunk>. A brief guide for practitioners about how to correct misinformation, available for download in seven languages. (An extended summary of the issue can be found in [Lewandowsky, Ecker, Seifert, Schwarz, & Cook, 2012](#).)

Oreskes, N., & Conway, E. M. (2010). *Merchants of doubt*. London, England: Bloomsbury Publishing. An in-depth historical analysis of the role of ideology in organized denial of well-established scientific facts.

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Results

	Rash got better	Rash got worse
Users of new skin cream	223	75
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